Better Buildings®
U.S. DEPARTMENT OF ENERGY

Better, Faster, Cheaper

Better Buildings Home Upgrade Program Accelerator

Dale Hoffmeyer
DOE

U.S. DEPARTMENT OF ENERGY

What is a Better Buildings Accelerator?

- Collaborative peer-to-peer networks designed to facilitate learning and leadership opportunities that result in new strategies and practices in clean energy development.
- focus on partner identified areas that aim to overcome persistent barriers.


ISSUE SPECIFIC


TIME BOUND


RESULTS-DRIVEN

Better Buildings Accelerators

Home Upgrade Program
Minimize program costs while improving and expanding program savings through the use of information technology and adoption of common data standards to streamline data exchange.

Home Energy Information
Expand the availability of energy information in residential real estate transactions to make energy-related information available to home buyers and sellers through multiple listings.

Clean Energy for Low Income Communities
Develop plans to identify funding that will lead to the implementation of expanded installation of energy efficiency and distributed renewables in low income communities.

Energy Savings Performance Contracting
Catalyze public-sector energy efficiency investments of $2 billion from January 2013 to December 2016 through the use of innovative and best-practice approaches to ESPC.

Data Centers
Reduce the infrastructure energy intensity of one or more data centers by 25 percent over a period of five years.

Combined Heat and Power Resiliency
Develop plans for communities to capitalize on CHP's strengths as a reliable, high efficiency, lower emissions electricity and heating/cooling source for critical infrastructure.

Better Buildings Accelerators

Smart Labs
Universities, federal agencies, national laboratories, hospitals, and corporations commit to advancing strategies that rapidly improve energy efficiency in laboratory buildings.

Zero Energy Districts
Districts demonstrate the practicality of taking action to cost effectively meet zero energy goals by completing a detailed energy master plan, business case, model, and development.

Industrial Superior Energy Performance
Utilities and administrators are deploying SEP programs across their service territories and manufacturers are implementing SEP across a corporation or multiple plants.

Outdoor Lighting
Accelerate the adoption of high-efficiency outdoor lighting and improve system-wide replacement processes.

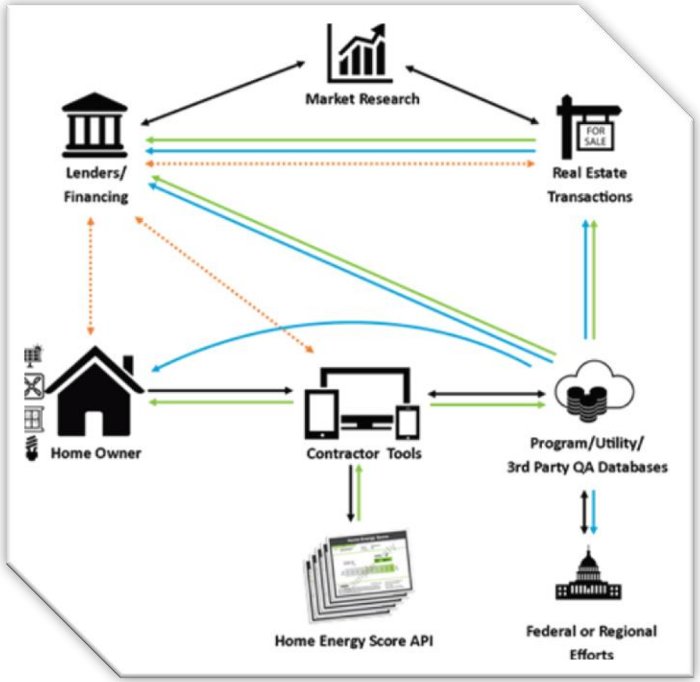
Wastewater Infrastructure
State, regional, and local agencies will work to improve the energy efficiency of water resource recovery facilities by at least 30 percent on their path to more sustainable infrastructure.

Combined Heat and Power Resiliency
Develop plans for communities to capitalize on CHP's strengths as a reliable, high efficiency, lower emissions electricity and heating/cooling source for critical infrastructure.

Home Upgrade Program Accelerator

Objective: Reduce the administrative burden and cost of programs by improving processes to:

- ✓ Manage and track home energy upgrades
- ✓ Review the quality of work
- ✓ Streamline data collection, management, & transfer (e.g., BEDES, HPXML)



1. Identify Process Improvements
2. Develop Strategy & Commit Resources
3. Implement Strategy & Test
4. Measure Impact

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Accelerator Partners

- APS
- NYSERDA
- Build It Green
- Enhabit
- Pearl Home Certification
- Building Performance Institute
- Midwest Energy Efficiency Alliance (MEEA)
- Neighborworks of Western Vermont HEAT Squad

Benefits

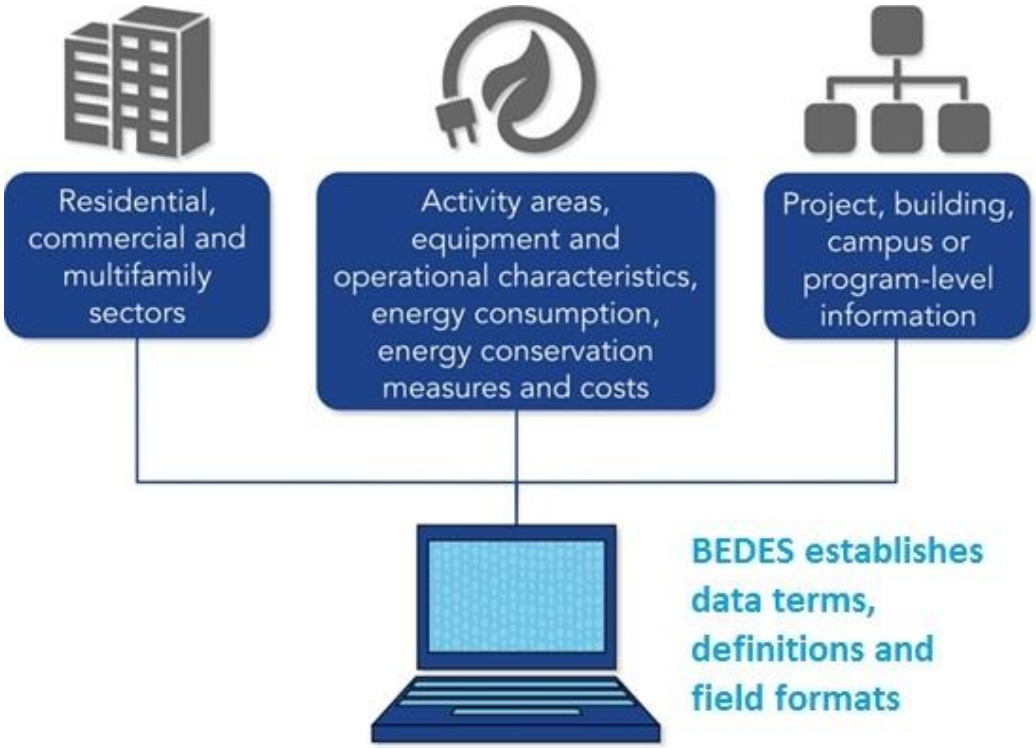
- ✓ Peer exchange of knowledge and experience
- ✓ Strategies to reduce program cost and enhance effectiveness, improve participating contractor satisfaction
- ✓ Receive public recognition as leader

Standardize Collection of Building Data

- Increase data interoperability between industry software system.
- Facilitate implementation consistency across jurisdictions to drive economies of scale.
- Create consistent, high quality, and large scale data sets to inform market research and valuation of EE resources.

Building Energy Data Exchange Specification (BEDES)

BEDES provides a common set of data terms, definitions and field formats that can be used by public and private software tools, data schemas and databases working within the building energy performance sector.



Home Performance XML

Building Performance Institute (BPI) standards for collecting and transferring home energy upgrade information.

- Dictionary of terms for home upgrades aligned with BEDES
  - Home Performance-Related Data Collection (BPI-2200)
- Schema for data transfer using extensible mark-up language (XML)
  - Home Performance-Related Data Transfer (BPI-2100)
  - **Key for machine to machine communication and automation**

EXAMPLE HPXML

```
<WaterHeatingSystem>
        <SystemIdentifier id="dhw1"/>
        <FuelType>natural gas</FuelType>
        <WaterHeaterType>storage water heater</WaterHeaterType>
        <Location>conditioned space</Location>
        <CombustionVentingSystem idref="combvent1"/>
</WaterHeatingSystem>
```

Standardize Specifications for Home Energy Upgrades

- Reflect a whole-house approach to installing energy-efficiency measures (e.g. ventilation, insulation, and air sealing).
- Establishes common expectations of quality work against which consumers, financers, and policymakers can measure performance of home energy-efficiency professionals.
- Supports the development of a skilled residential energy upgrade workforce.

Specification Example

4.1006.1 Pull-Down Stairs

Topic: Attics
Subtopic: Attic Openings
4.1006.1 Detail Name: Pull-Down Stairs
Desired Outcome: Pull-down attic stair properly sealed and insulated

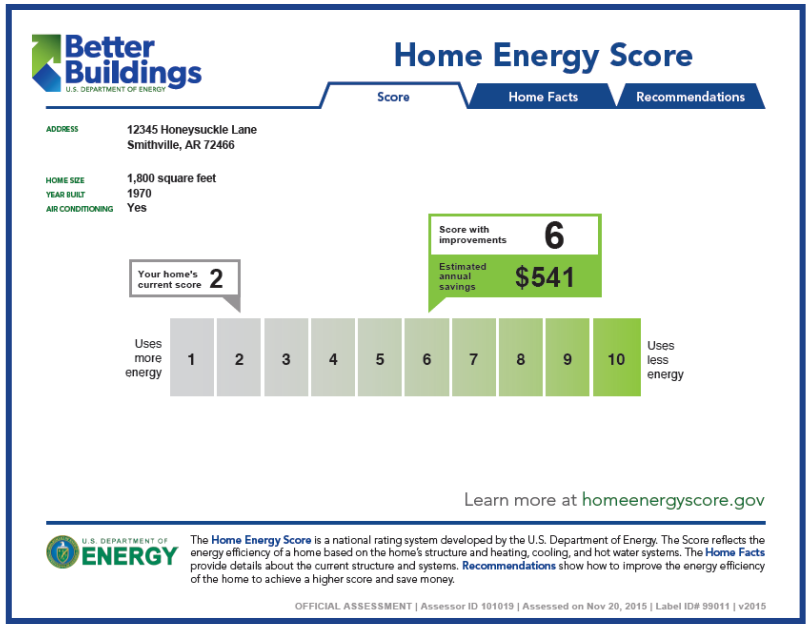
ROW	TITLE	SPECIFICATION(S)	OBJECTIVE(S)
4.1006.1a	Installation	Hatches will be insulated with non-compressible insulation and the measure will include a protective barrier or baffle Pull down stair assembly will be insulated to the same R-value as the adjoining insulated assembly Pull down stair rough opening will be surrounded with a durable dam that is higher than the level of the attic floor insulation	Achieve uniform R-value Prevent loose insulation from entering the living area

The ***Specification*** defines the minimum level of action required to meet the ***Objective***.

The ***Objective*** defines the required outcomes of the work.

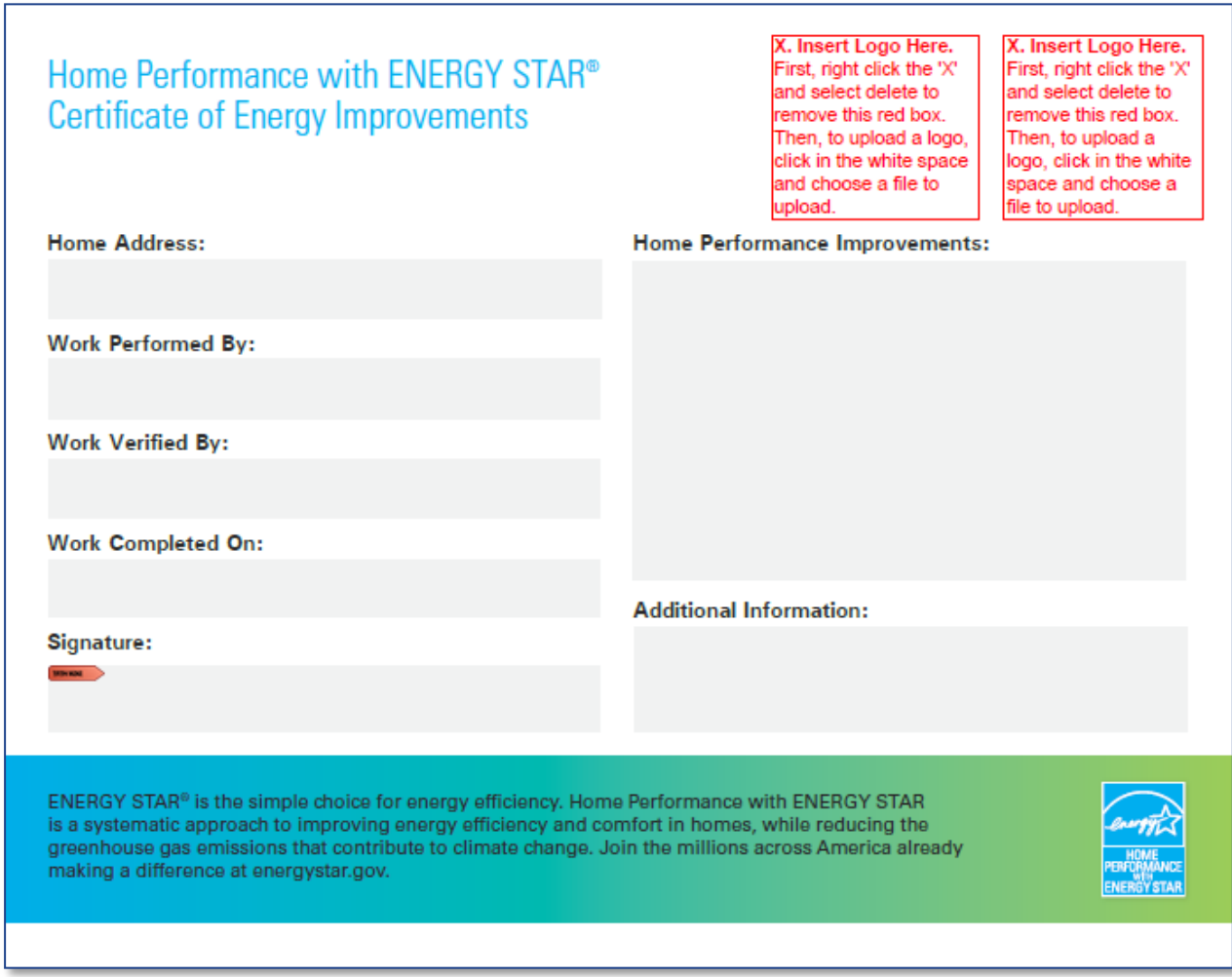
Home Energy Score HPXML Translator

- A translator automatically simplifies complex, HPXML-formatted home data into inputs to generate a Home Energy Score
- Minimizes need to customize assessment software



HPwES Certificate of Completion

Auto-populate certificate of completion using HPXML



Home Performance with ENERGY STAR®
Certificate of Energy Improvements

X. Insert Logo Here. First, right click the 'X' and select delete to remove this red box. Then, to upload a logo, click in the white space and choose a file to upload.

X. Insert Logo Here. First, right click the 'X' and select delete to remove this red box. Then, to upload a logo, click in the white space and choose a file to upload.

Home Address:

Work Performed By:

Work Verified By:

Work Completed On:

Signature:

Home Performance Improvements:

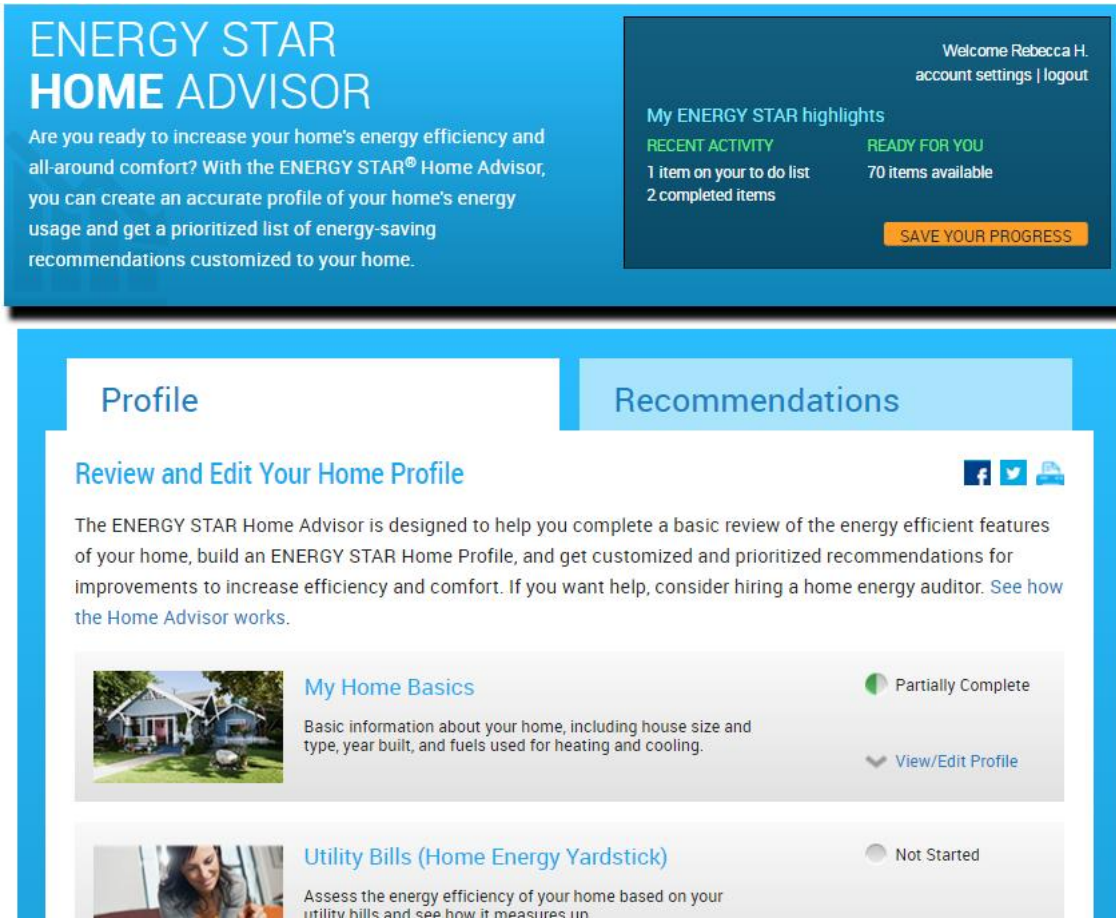
Additional Information:

ENERGY STAR® is the simple choice for energy efficiency. Home Performance with ENERGY STAR is a systematic approach to improving energy efficiency and comfort in homes, while reducing the greenhouse gas emissions that contribute to climate change. Join the millions across America already making a difference at energystar.gov.

HOME PERFORMANCE with ENERGY STAR

ENERGY STAR Home Advisor

- Auto populate using HPXML
- Developing HPXML export to facilitate interactions with other systems.



www.energystar.gov/homeadvisor

Questions? Email: Hudson.Rebecca@epa.gov for more information

Home Performance Community Tools

- www.hpxmlonline.com provides information on the data standard, the value for the building performance industry, and tools to help programs and software developers.
- Online standard workforce specification tool (sws.nrel.gov) can be leveraged in energy audits, scopes of work, quality control, training and field guides.

Visit the Residential Program Solution Center: energy.gov/rpsc

Suggestions? Email BBRPSolutionCenter@ee.doe.gov

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Process Innovations to Accelerate Home Upgrade Programs

Dec 15th, 2016

Chris Baker
Program Manager,
Home Performance with ENERGY STAR
Arizona Public Service

aps

Context

Started 2010

BPI BA process for the assessment.

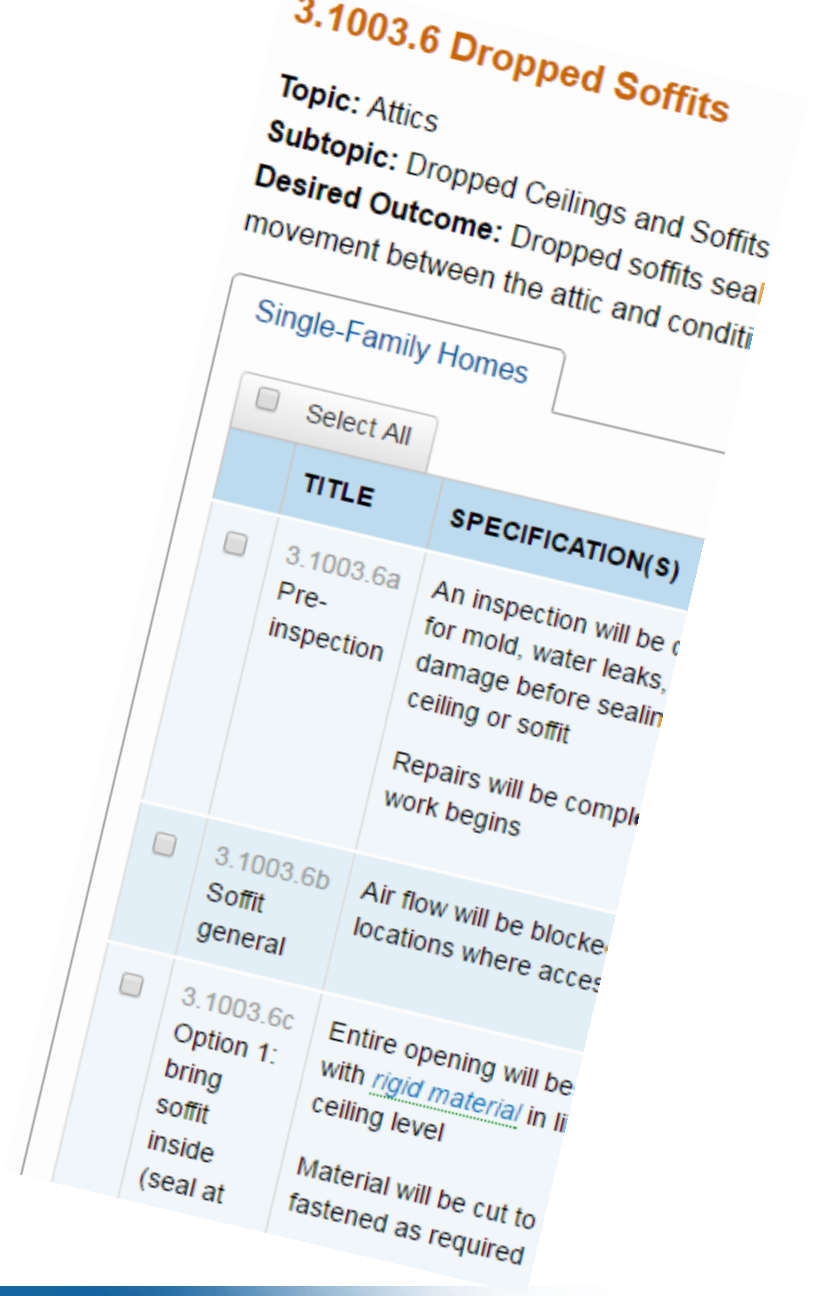
Mandatory software for modeling and project submission

Between 2,000- 4,000 projects a year

Worked on the SWS committee in 2010 with NREL.

The Draft version of that document became the work quality requirements for HPwES.

All contractors had to sign a document acknowledging all policies and procedures.



Old Program Management Software.

Buggy, Slow, frequent crashes and issues.

Integrated program software and modeling tool.

Had to create several “work-a-round's” for our stock / climate

Improvements Software 2012/13

Shifted to flexible software for program management

Receives and aggregates HPXML files, invoices, rebate forms for easy access

Allowed contractors to choose their own modeling software.

Web based. Fast. Easy.

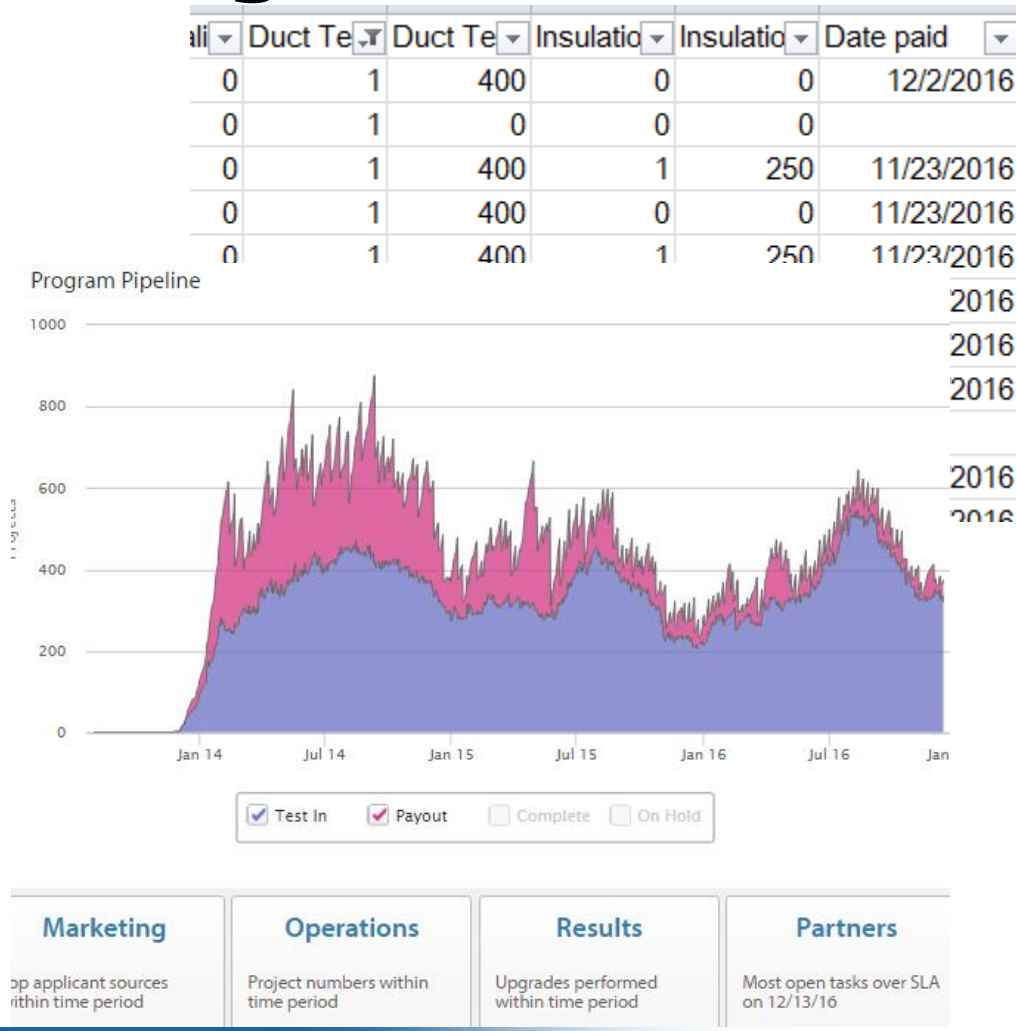
Improvements Software program management

Improved visibility into program operations.

All necessary information in one place for Program managers & M&V

Insights into marketing effectiveness

Insights into contractor performance



Improvements Software

This reduced QA admin labor by 50%

Increased contractor satisfaction 50%

31% Decrease in contractor admin labor reporting

Contractor reports became customizable and sales rates increased

Improvements Measures

Quality of work varied among contractors.

Training for new hires or crew turnover especially problematic.

Contractors were getting a lot of callbacks to fix simple problems.

Contractor profits impacted.

Improvements Measures

FSL Partnered with Advanced Energy and created the "Critical Details"

Initially developed for WAP, adapted to HPWES.

Training for all contractors on how to use the critical details for in house training, and QC.

Critical details became standard on all corrective action reports following a failed inspection.

Improvements Measures

Contractors now receive quarterly scorecards

Top 5 Contractor of the year awarded in January

Special marketing benefits to winners

Has created some friendly competition

2016 Q3 HPwES Scoreca

Performance contractor

Your company is currently Ranked

5th/35

easure	Scope	Survey	Overall
2.97	3.00	9.63	9.77
2.99	3.00	9.94	9.96
2.50	3.00	9.00	8.83

Current Annual numbers

Approximately 3200 Audits.

40% conversion rates.

All contractors are rated 1-10

#1 – 9.96

#35 – 8.83

Takeaways

Whole house programs cannot exist without good contractors.

Good contractors need to be profitable.

Good contractors need consistent training

Designing and evolving programs should be done with contractor input, and with their perspective in mind.

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Case Study: Improving Arizona Hom

HOME UPGRADE PROGRAM ACCEL

Home Performance with ENERGY STAR® (HPwES) encourages a whole-home assessment approach to provide the most comfortable, efficient living space, looking at all systems for improvement. Since launching the Arizona HPwES program in March 2010, electric utility Arizona Public Service (APS) and Arizona's HPwES Sponsor, FSL Home Energy Solutions (FSL), have focused on continuous improvements designed to elevate customer and contractor experience while boosting program cost-effectiveness.

The program saw success in its early years of implementation, quickly growing to serve more than 2,300 homes in its second program year and more than 4,000 in its sixth year. During this program expansion, three areas for improvement emerged:

- **Contractor satisfaction:** Participating contractors were frustrated that the program's mandatory energy assessment software was difficult and time-consuming to use. Contractors also complained that the program's home energy reports were

Keys to Home Performance Program Improvements

- **Simplicity:** A whole-home upgrade is a complicated endeavor, but that does not mean that whole home programs need to be equally complicated. Exploring every avenue to streamline and automate program steps can lower implementation costs.
- **Standardization:** Streamlining a program requires transparent and well-defined program standards. The Arizona HPwES program looked to industry efforts, including the Standard Work Specifications for Home Energy Upgrades (SWS) and Home Performance Extensible Markup Language (HPXML), as the cornerstone for program improvements.
- **Flexibility:** HPXML enabled the program to open its market to a wide range of energy assessment tools. Access to these tools gave contractors more choice and control of how they delivered home performance.
- **Quality:** Delivering consistent and reliable upgrades not only requires a definition of quality, but also a means to manage that quality over time and across all personnel, both program and contractor.

aps

Thanks

Chris.C.Baker@aps.com

Example APS Scorecard

HOME PERFORMANCE WITH ENERGY STAR

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Your 2016 Q4 HPwES Scorecard

Jon Doe Home Performance:

Your company is currently Ranked

6th/39

	Measure	Scope	Survey	Overall	Total
Your Company	3.00	3.00	9.50	9.75	9.76
Top Company	2.98	3.00	9.93	9.94	9.98
Bottom company	1.92	3.00	5.00	6.06	NA

Achievement rate – 148%

HOME PERFORMANCE WITH ENERGY STAR

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Q4 Scorecards:

This is the final scorecard for 2016. These scores are considered in the awarding of the Top 5 Contractors of the year for 2017.

1. These scores are based on the FSL scores for the last 4 quarters only. (Jan 1st – Dec. 16th 2016).

2. In order to qualify for Contractor Of the Year, you must have had a minimum of 10 retrofits, and 5 inspections in the last 4 quarters. For every 10 retrofits completed in the last 4 quarters, an additional 0.01 points is added to your overall score. Once the adjusted scores were tabulated ties were broken by adding 0.01 points to the company with more retrofits.

The Total Score column is your FSL overall score with the above factors added in.

If you had less than 10 retrofits, or 5 inspections recorded in the last 4 Quarters, you will see an NA for your ranking.

Achievement Rates

As stated with the Q2 Scorecards, achievement rates do not affect your scores for 2016. I am including them when available for informative reasons. These will become more important in 2017. 100% is right on target, over 100% is exceeding expectations, and less than 100% is not producing the savings expected.

Chris Baker,
Manager, HPwES
APS

Residential Home Upgrades in California

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Build It Green
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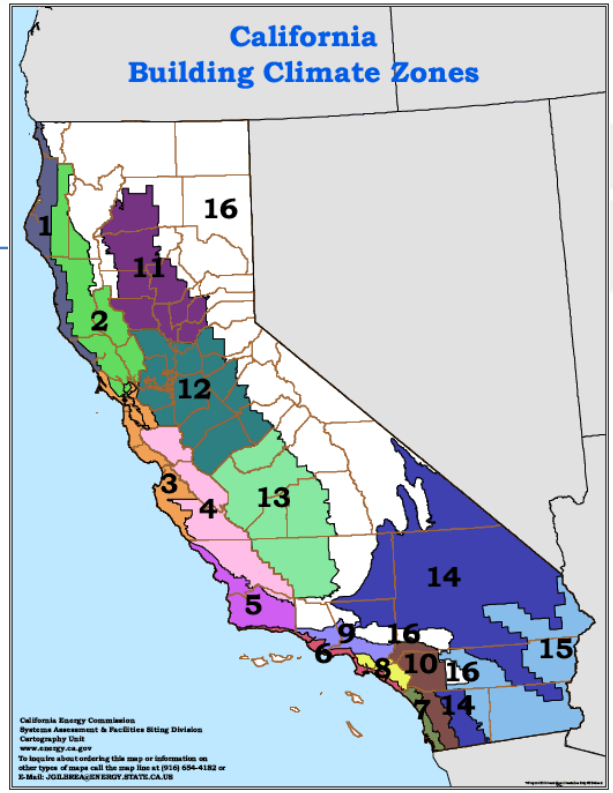
AESP Webinar
Dec 2016

Home Upgrade
Energy Upgrade California®

Presentation Outline

- Introduction
- Home Upgrade Program Issues, Process & Solutions
- Home Upgrade Program Accelerator Metrics & Results
- Timeline
- Goals



Home Upgrade
Energy Upgrade California®

Introduction

Build It® Green is a non-profit green building standards development, training and program implementation services organization.

Introduction

Build It Green® is implementer for the Home Upgrade program, under the statewide Energy Upgrade California 'programs umbrella', in the Pacific Gas and Electric (PG&E) service territory, as well as the service territory that PG&E shares with the Southern California Gas Company (SoCal Gas).

Introduction

The Home Upgrade Program (HUP) participation consists of:

- **150 Participating Contractors**
- **3,000 – 5,000 Upgrade Project Rebates Issued Annually**
- **2 Program pathways**
  - Home Upgrade pathway is prescriptive measures based
  - Advanced Home Upgrade pathway requires energy modeling (Pre- and Post-Installation)

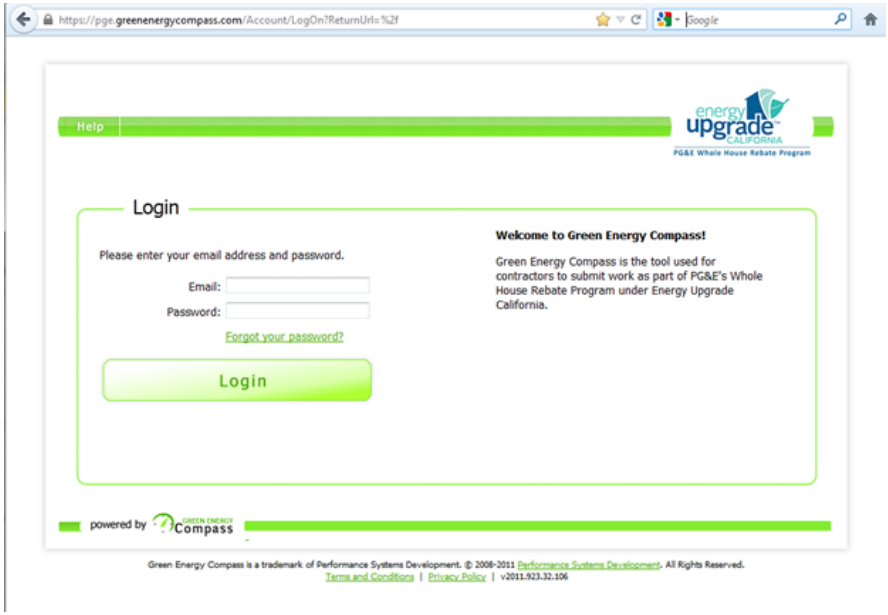
Home Upgrade Program Issues

- Program is **complicated** and requires ongoing training and mentoring
- Initially, the Advanced program had **only one approved energy modeling software tool**
- Program requires a significant amount of **time-consuming data collection and document submission**
- Rebate application **process** is lengthy and (initially) **unnecessarily complex**
- Job-submission **staff turnover can cause delays** during 'learning-curve'
- Modeled energy **savings** is **not as accurate as desired**

Home Upgrade Program Issues

Biggest initial pain-point:

- Rebate application process is lengthy and (initially) unnecessarily complex



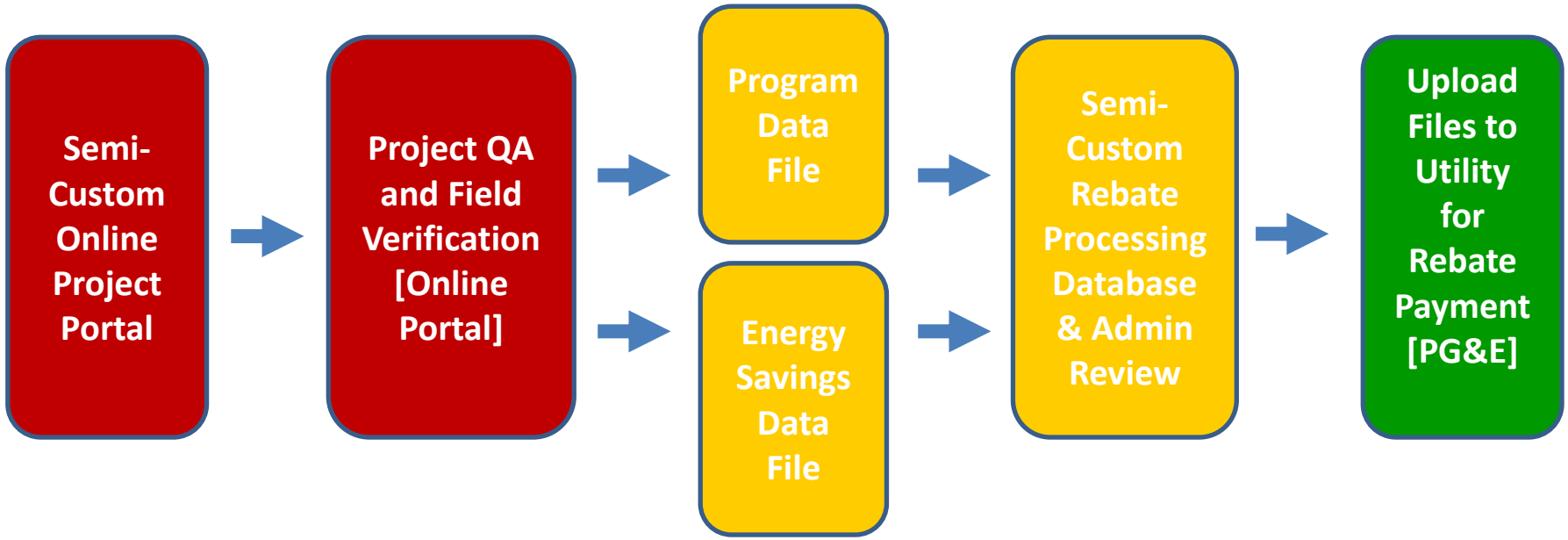
Focus on:

Information Systems

(i.e., the thing we had the most control of)

Home Upgrade Program Process

2011-2014



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Home Upgrade Program Issues

Process advantages for 'Semi-Custom' portal/database solutions:

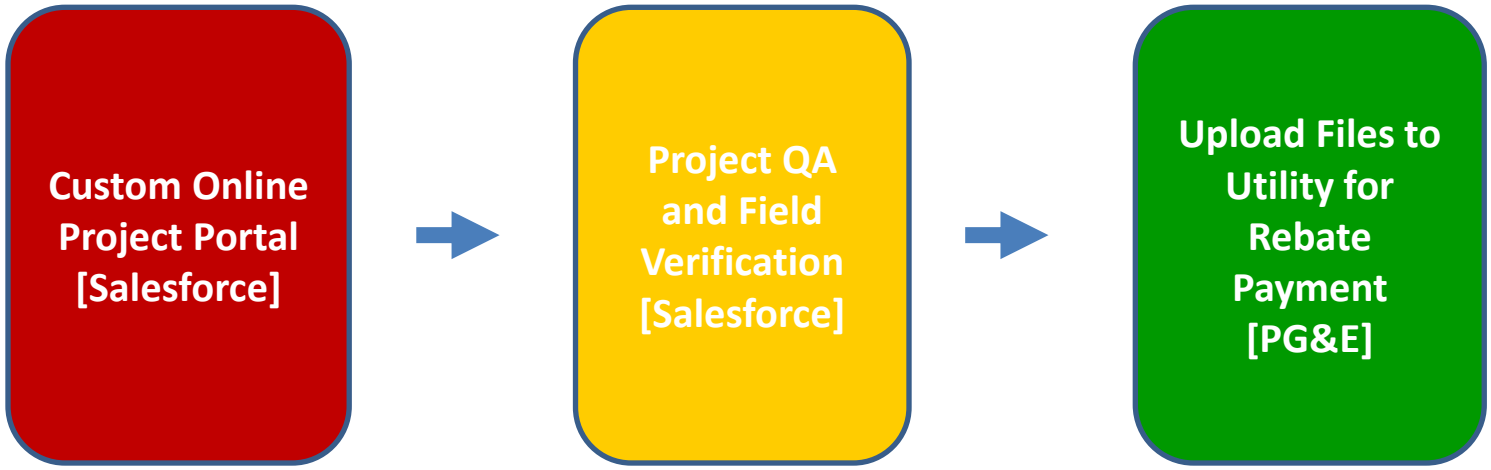
- Off-the-shelf solution to launch Program

Process drawbacks for 'Semi-Custom' portal/database solutions:

- Difficult to update features without significant impacts on users
- Difficult to track application documentation updates (good notes required!)
- Design included significant amount of manual aggregation of data in order to move to next step in process
- Reporting capabilities were not as flexible as needed
- More steps = More potential for data errors in transfer

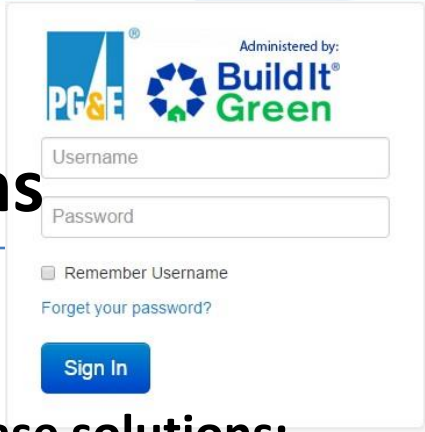
Home Upgrade Program Process

2015-Current



Home Upgrade
Energy Upgrade California®

Home Upgrade Program Issues & Solutions



Process advantages for fully 'Custom' integrated portal/database solutions:

- Regular, flexible feature updates built on stable, standardized platform (Salesforce) minimize impacts on users and increases efficiency
- Iterative application documentation tracking (good notes still recommended!)
- Automated data aggregation speeds move to next step in process significantly
- Reporting capabilities are as flexible as needed (design for standardization of data where possible)
- Fewer steps = Limited potential for data errors in transfer

Process drawbacks for fully 'Custom' portal/database solutions:

- Initial Cost

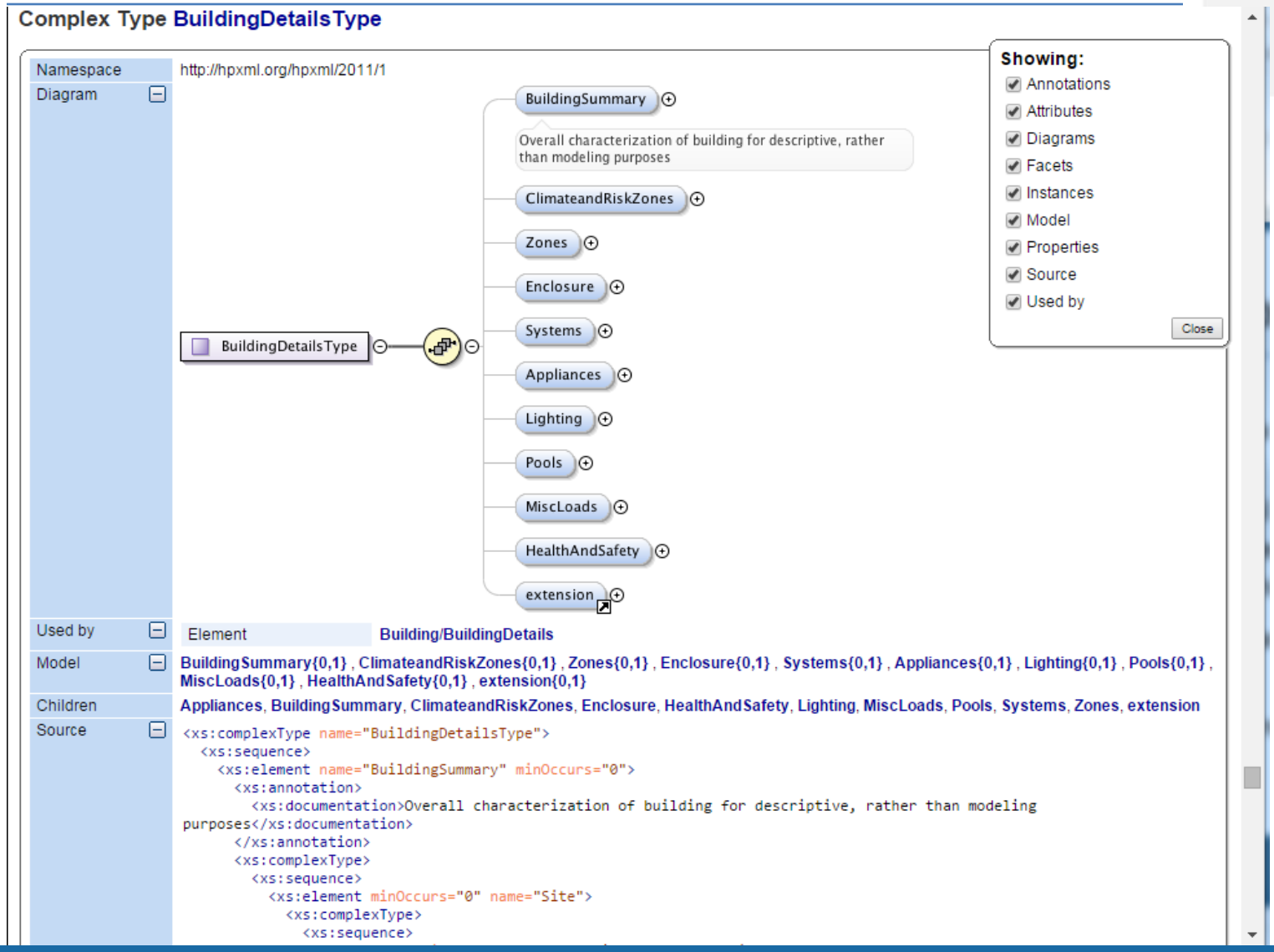
Home Upgrade Program Solutions

Addressing other Pain-Points:

- **Reduce unnecessary and/or manual data entry and documentation**
  - Parse data and 'auto-populate' from transparent, standardized energy modeling output (HPXML)
  - Online, dynamic, database-integrated 'test-measurements' form to minimize manual data transfer and user-error
  - Choice of 'less-detailed' software options

These solutions can increase efficiency and save time/money, but might they help reduce staff turnover as well?

HPXML Standard/Structure Maintained by DOE (NREL)



HPXML Structure Based on BPI & DOE Standards

Building Performance Institute, Inc.
BPI Standards

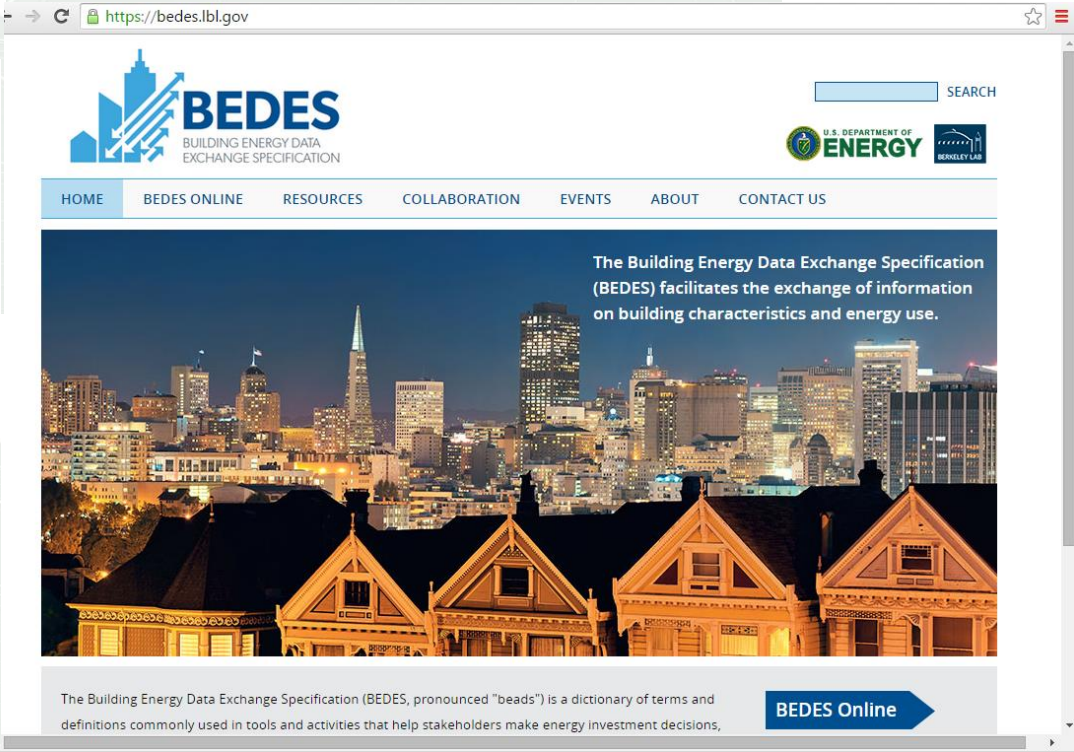
ANSI/BPI-2400-S-2012
Standard Practice for Standardized Qualification of Whole-House Energy Savings Predictions by Calibration to Energy Use History

Building Performance Institute, Inc.
BPI Standard

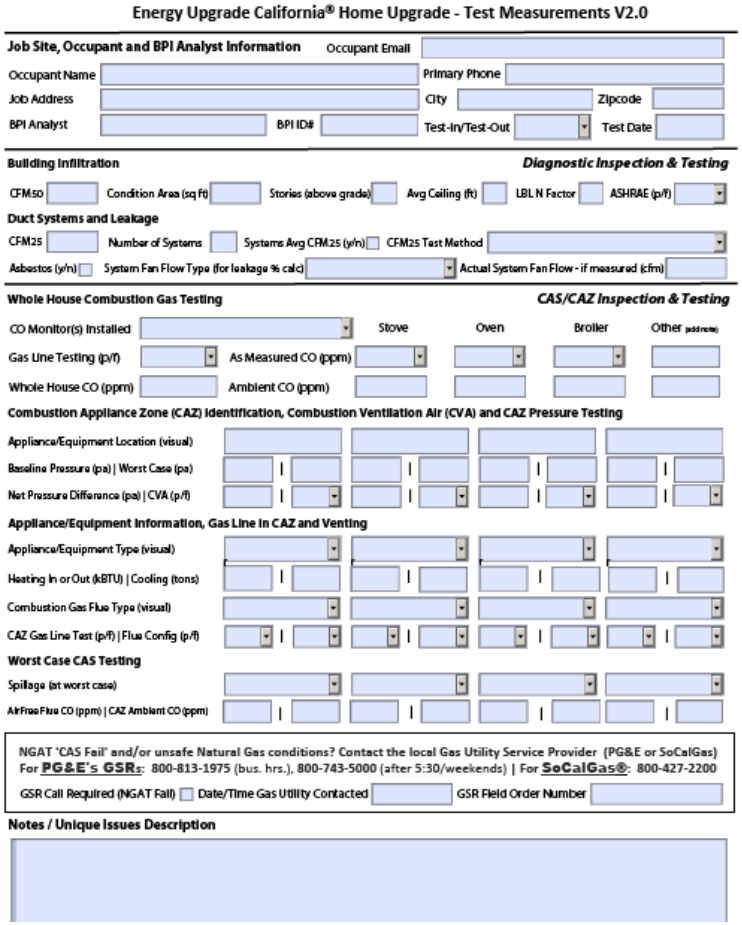
BPI-2100-S-2013
Standard for Home Performance-Related Data Transfer v2.1.0

Building Performance Institute, Inc.
BPI Standard

BPI-2200-S-2013
Standard for Home Performance-Related Data Collection v2.1.0



Test Measurements Form



Energy Upgrade California® Home Upgrade - Test Measurements V2.0

Job Site, Occupant and BPI Analyst Information Occupant Email

Occupant Name | Primary Phone

Job Address | City | Zipcode

BPI Analyst | BPI ID# | Test-In/Test-Out | Test Date

Building Infiltration — ***Diagnostic Inspection & Testing***

CFM50 | Condition Area (sq ft) | Stories (above grade) | Avg Ceiling (ft) | LBL N Factor | ASHRAE (p/f)

Duct Systems and Leakage

CFM25 | Number of Systems | Systems Avg CFM25 (y/n) | CFM25 Test Method

Asbestos (y/n) | System Fan Flow Type (for leakage % calc) | Actual System Fan Flow - if measured (cfm)

Whole House Combustion Gas Testing — ***CAS/CAZ Inspection & Testing***

CO Monitor(s) Installed | Stove | Oven | Broiler | Other (address)

Gas Line Testing (p/f) | As Measured CO (ppm)

Whole House CO (ppm) | Ambient CO (ppm)

Combustion Appliance Zone (CAZ) Identification, Combustion Ventilation Air (CVA) and CAZ Pressure Testing

Appliance/Equipment Location (visual)

Baseline Pressure (pa) | Worst Case (pa)

Net Pressure Difference (pa) | CVA (p/f)

Appliance/Equipment Information, Gas Line in CAZ and Venting

Appliance/Equipment Type (visual)

Heating In or Out (kBTU) | Cooling (tons)

Combustion Gas Flue Type (visual)

CAZ Gas Line Test (p/f) | Flue Config (p/f)

Worst Case CAS Testing

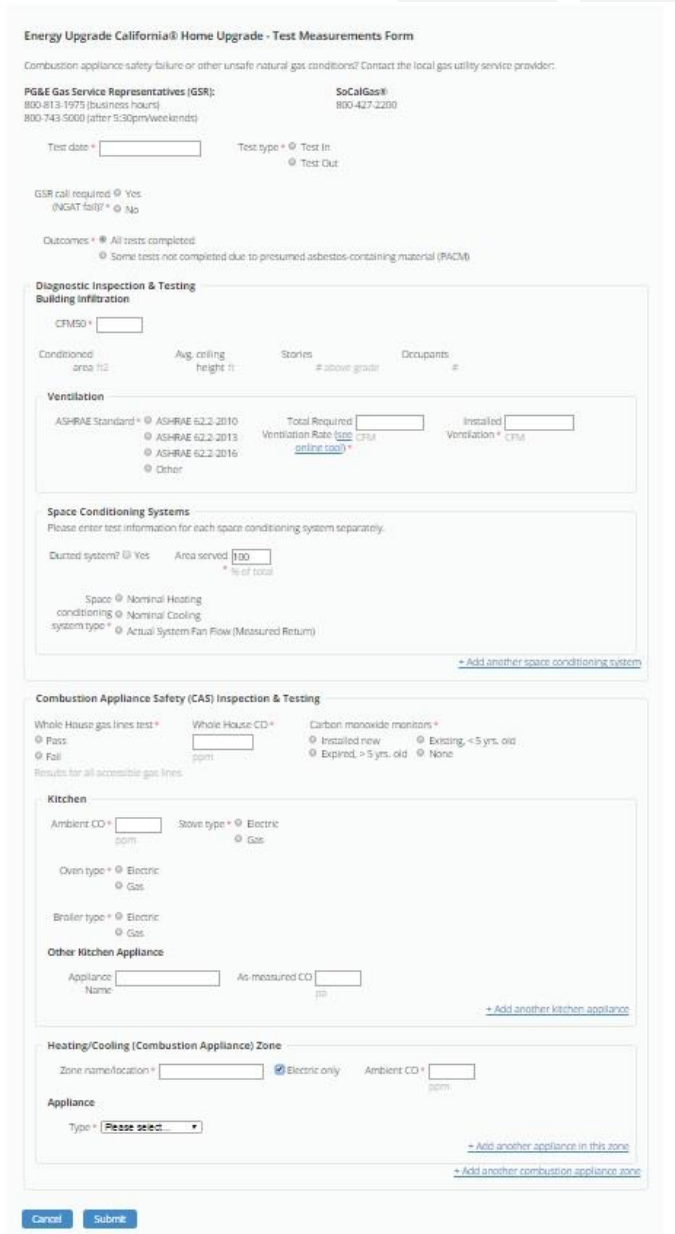
Spillage (at worst case)

Air Free Flue CO (ppm) | CAZ Ambient CO (ppm)

NGAT 'CAS Fail' and/or unsafe Natural Gas conditions? Contact the local Gas Utility Service Provider (PG&E or SoCalGas)
For **PG&E's GSRs**: 800-813-1975 (bus. hrs.), 800-743-5000 (after 5:30/weekends) | For **SoCalGas®**: 800-427-2200

GSR Call Required (NGAT Fail) | Date/Time Gas Utility Contacted | GSR Field Order Number

Notes / Unique Issues Description



Energy Upgrade California® Home Upgrade - Test Measurements Form

Combustion appliance safety failure or other unsafe natural gas conditions? Contact the local gas utility service provider:

PG&E Gas Service Representatives (GSR):
800-813-1975 (business hours)
800-743-5000 (after 5:30pm/weekends)

SoCalGas®
800-427-2200

Test date * | Test type * Test In / Test Out

GSR call required (NGAT fail)? * Yes / No

Outcomes * All tests completed / Some tests not completed due to presumed asbestos-containing material (PACM)

Diagnostic Inspection & Testing

Building Infiltration

CFM50 *

Conditioned area ft2 | Avg. ceiling height ft | Stories # above grade | Occupants #

Ventilation

ASHRAE Standard * ASHRAE 62.2-2010 / ASHRAE 62.2-2013 / ASHRAE 62.2-2016 / Other

Total Required Ventilation Rate (see online tool) * CFM | Installed Ventilation * CFM

Space Conditioning Systems

Please enter test information for each space conditioning system separately.

Ducted system? Yes | Area served 100 % of total

Space conditioning system type * Nominal Heating / Nominal Cooling / Actual System Fan Flow (Measured Return)

+ Add another space conditioning system

Combustion Appliance Safety (CAS) Inspection & Testing

Whole House gas lines test * Pass / Fail — Results for all accessible gas lines

Whole House CO * ppm

Carbon monoxide monitors * Installed new / Existing, < 5 yrs. old / Expired, > 5 yrs. old / None

Kitchen

Ambient CO * ppm | Stove type * Electric / Gas

Oven type * Electric / Gas

Broiler type * Electric / Gas

Other Kitchen Appliance

Appliance Name | As-measured CO ppm

+ Add another kitchen appliance

Heating/Cooling (Combustion Appliance) Zone

Zone name/location * | Electric only | Ambient CO * ppm

Appliance

Type * Please select

+ Add another appliance in this zone

+ Add another combustion appliance zone

Cancel | Submit

At-a-Glance Software Comparison Guide

Home Upgrade
Energy Upgrade California®

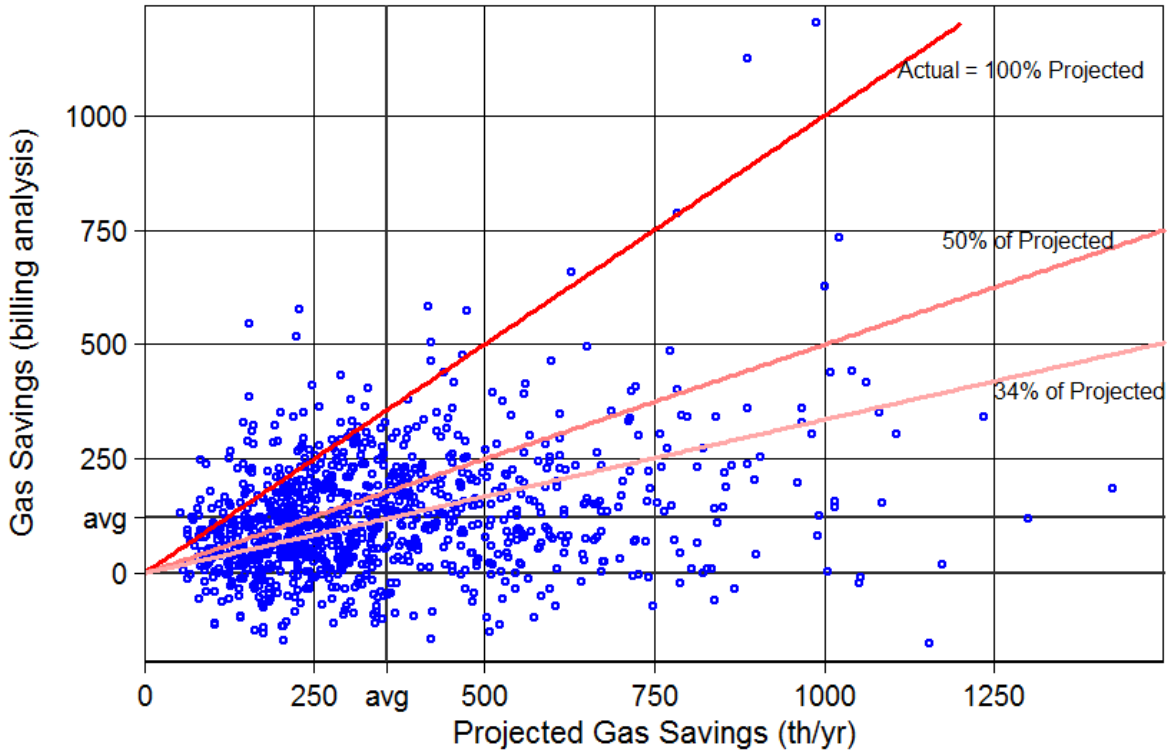
Home Upgrade Program Solutions

Addressing other Pain-Points:

- **Increase energy-modeling accuracy for better Program energy savings and satisfaction**
  - Launch mechanism for comparison of energy-modeled predictive savings results with pre- and post-installation customer bill data (CalTRACK)
  - Provide realization-rate feedback to energy modeling software vendors to improve tools
  - Provide realization-rate feedback to contractors to target areas that need improvement with more specific training and mentoring (potentially introduce ‘contractor scores’)

Is the Program Delivering Savings?

Actual (billing analysis) vs. Projected Gas Savings

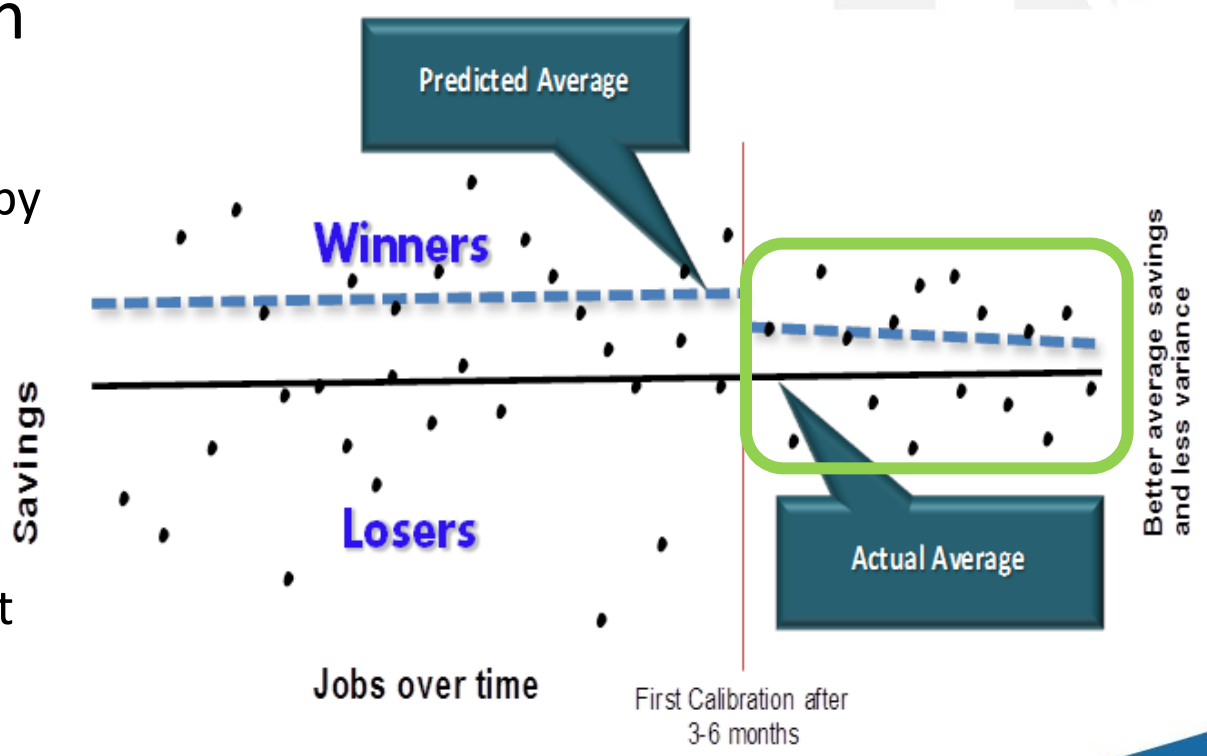


Home Upgrade
Energy Upgrade California®

CalTRACK: Delivery of Predicted Savings

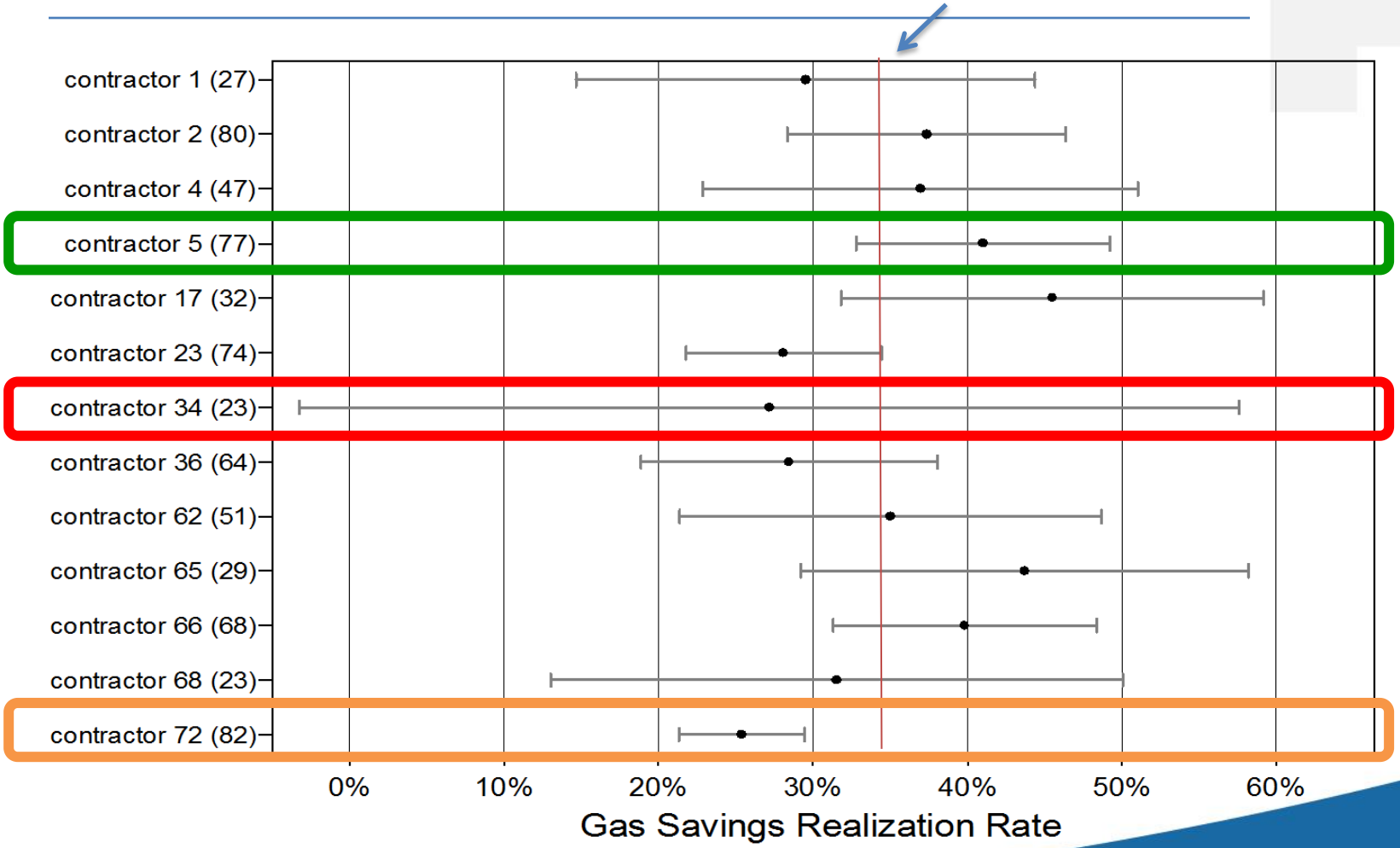
California Data-Driven Tracking and Analysis

- Upgrade projects tracked by software version used
- Savings predictions compared to weather normalized post retrofit billing data
- If inaccuracies identified at the software level, vendor can revise software or an adjustment factor can be applied to reconcile future model predictions



CalTRACK: Contractor Feedback

Avg. Gas Realization Rate (2010-2012 Data): 34%



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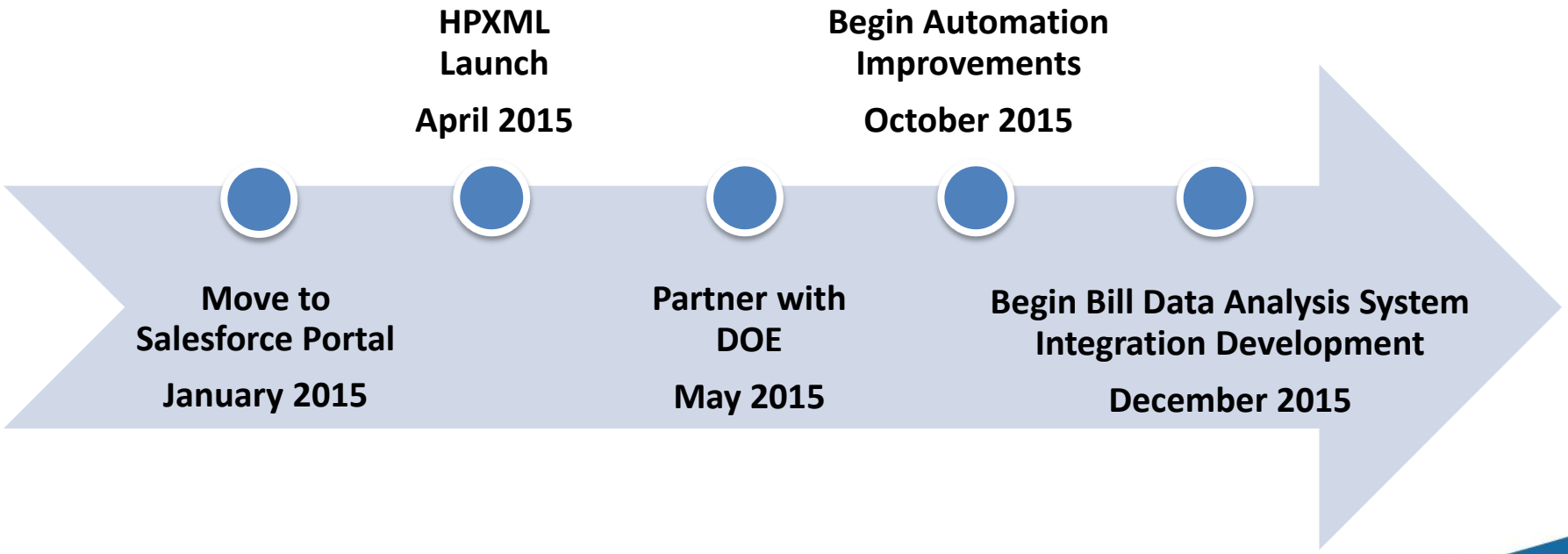
Home Upgrade Program Accelerator Metrics

1. Reduce administrative time to review rebate applications by 25% (per project)
2. Expand contractor choice of energy modeling software tools
3. Reduce the reporting burden on contractors by 25% (per project)
4. Improve contractors' satisfaction in the program by 20% (based on surveys)
5. Benchmark predictive accuracy of modeled energy savings and reduce average difference between predicted and actual savings by 10%

Home Upgrade Program Accelerator Results

1. Reduced administrative time to review rebate applications by 48%
2. Expanded contractor choice of energy modeling software tools to 3
3. Reduced the reporting burden on contractors by 27% in avg. application submission time and 20% in avg. energy modeling time
4. Improved contractors' satisfaction in the program by 28%
5. Benchmarking of predictive accuracy of modeled energy savings is **in progress**; reducing average difference between predicted and actual savings by 10% is next (upon completion of benchmarking)

HUP Improvements Timeline - 2015



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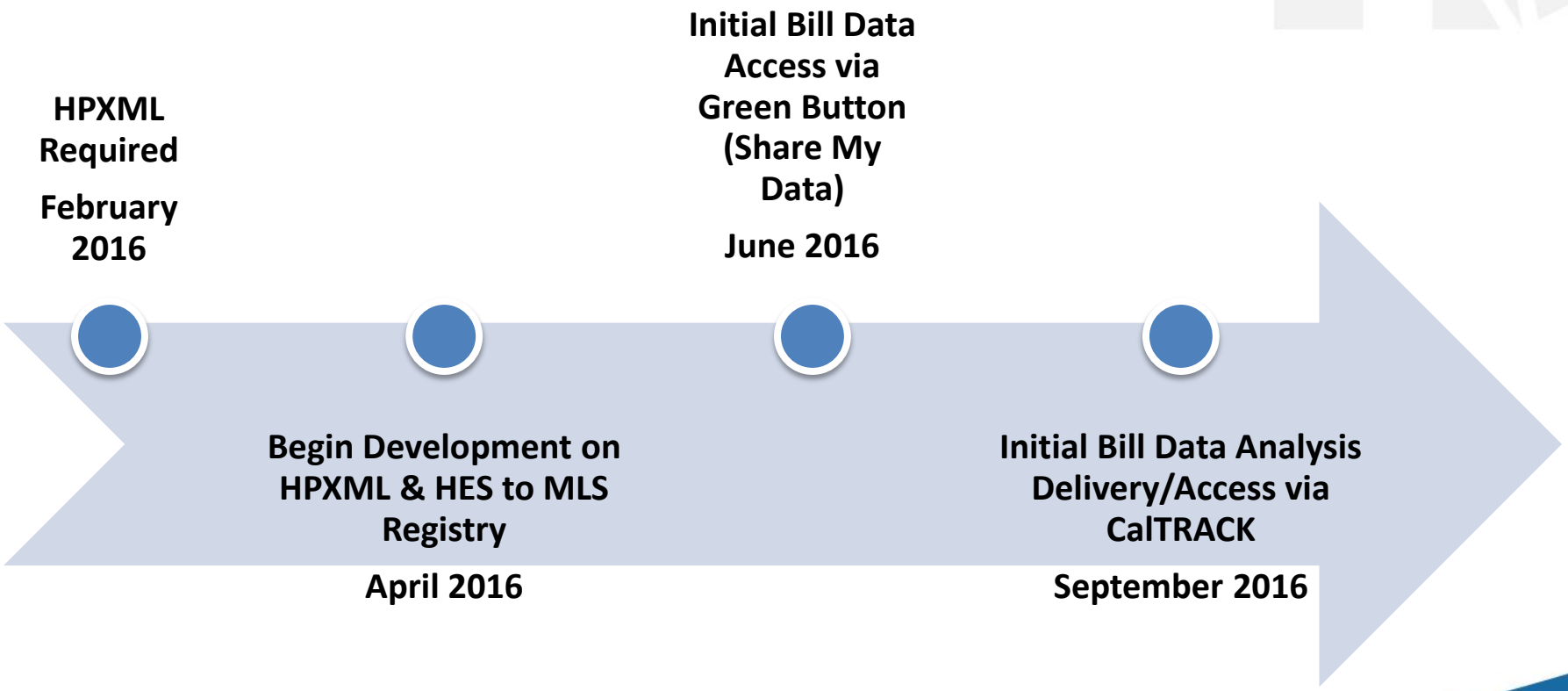
HUP Improvements Timeline - 2016



Long-Term Goal: Market Transformation

Indirect benefits that HUP improvements can facilitate:

- Driving demand/quantifying value of energy efficiency work
  - ✓ Home Energy Score via HPXML
  - ✓ Bringing green building data to the MLS via HPXML
- Designing better, more cost-effective programs
  - ✓ Less risk (greater predictability) for investors
  - ✓ Better environment for private capital and industry investment
  - ✓ Standardized (HPXML) data sharing and comparative analysis between other states, organizations and industries

Questions and Comments

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Thank You

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